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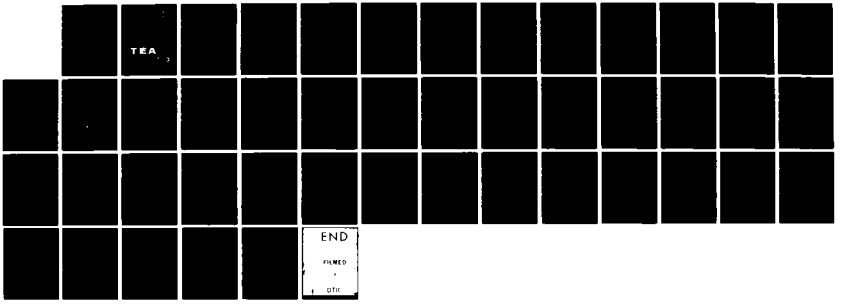
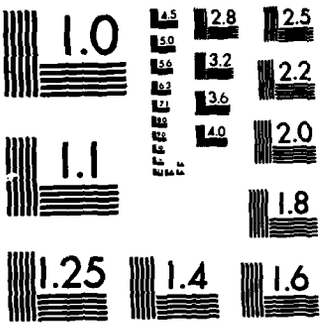
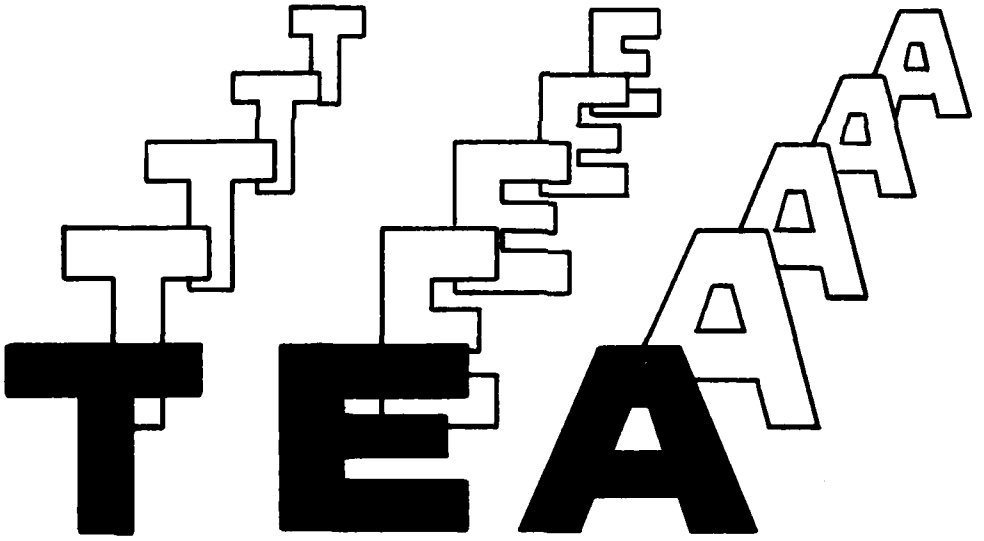




TRASANA TR-49-82
(REVISION 1)

TRAINING EFFECTIVENESS ANALYSIS

A PROCESS IN EVOLUTION



OCTOBER 1982

DEPARTMENT OF THE ARMY
US ARMY TRADOC SYSTEMS ANALYSIS ACTIVITY
WHITE SANDS MISSILE RANGE
NEW MEXICO 88002

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This revision supersedes TRASANA TR -49-82. However, only some administrative changes were made on the revision. All text remains in tact.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Training Effectiveness Analysis (TEA)
Cost and Training Effectiveness Analysis (CTEA)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Training Effectiveness Analysis--A Process in Evolution is a report which provides a brief history of the TEA Division in TRASANA, what the Division has done, who the Division supports, a brief section on methods used in Training Effectiveness Analyses, and what the Division has learned about Army training and conducting evaluations. Also included is a summary of the cost analysis in TEAs which is done by the Resource Analysis Branch, Special Studies Division. The Division has completed over 30 reports for eleven proponents since Oct 78. Included in these reports are analyses of the soldier, trainer, training

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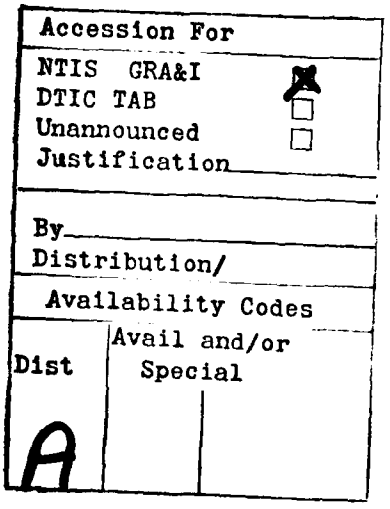
20. ABSTRACT (Continued)

subsystem, hardware subsystem and training environment. Other subjects more specifically stated include the evaluation of training on new equipment, unit training, institutional training, training devices, soldier selection criteria, and soldier/hardware interface.

TRAINING EFFECTIVENESS ANALYSES

A PROCESS IN EVOLUTION



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Systems Analysis Activity

PURPOSE

The purpose of this report is to familiarize the reader with the training effectiveness analysis (TEA) process as conducted by the TEA Division of the TRADOC Systems Analysis Activity, White Sands Missile Range, New Mexico. The report includes a brief history of the Division, a listing of all TEA projects completed to date, a discussion of the basic concepts underlying the TEA process, summary presentations of TEA procedures, techniques and problem areas, and a consideration of future developments and directions.

This is not a "how to" report. The reader who is planning to conduct a training effectiveness analysis should refer to the TEA Handbook (Draft) for procedural details. This report may prove useful as a reference to studies already completed in certain areas. Completed TEAs are available through the Defense Technical Information Center (DTIC). TRASANA has a limited supply of some of the reports.

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WHO ARE WE?

The Training Effectiveness Analysis (TEA) Division of the TRADOC Systems Analysis Activity (TRASANA) has been in existence for slightly less than four years. Although relatively new to the Army, the Division has made significant contributions toward the development of more effective training programs. Presented below is an overview of the TEA Division's organization, history, and structure.

TRASANA--THE PARENT ORGANIZATION

In July of 1974, a group of scientists and engineers associated with the SAFEGUARD Systems Evaluation Agency at White Sands Missile Range in New Mexico, were organized under the Army's Training and Doctrine Command (TRADOC) as the TRADOC Systems Analysis Activity (TRASANA). Today, TRASANA employs over 200 analysts, both civilian and military, possessing a variety of special skills including physical scientists, operations research analysts, economists, psychologists, training systems analysts, statisticians, mathematicians, and engineers. The mission of TRASANA, more fully stated in TRASANA Pamphlet 10-1, is to serve as an analytical center for combat and training developments and to conduct analyses necessary to support the TRADOC Commander's responsibilities in the weapons system acquisition process. The activity is divided into eight technical divisions and three administrative and support divisions, each with its own particular responsibilities (see Figure 1, TRASANA Organizational Chart). The analysis activities of these divisions cover a broad array of weapon and training systems. These include cost and operational effectiveness analyses (COEA), survivability and vulnerability analyses, validation of wargame simulations, development of force-on-force combat models, and training effectiveness analyses (TEA). Highlighted in the organizational chart are the Training Effectiveness Analysis Division and the Resource Analysis Branch, Special Studies Division. Although the emphasis of this report is on the activities of the TEA Division, an integral part of many TEA is cost analysis which is conducted by the Resource Analysis Branch. The organizational chart also highlights the TEA Management Agent who is responsible for establishing the TEA priority list and permeating the TRADOC TEA system throughout TRADOC and the Army.

THE TEA DIVISION

Prior to the formation of the TEA Division, training analyses were somewhat dispersed throughout TRASANA. Training studies were conducted by the Armor, Artillery, and Special Studies Divisions. TRADOC's recognition of the importance of TEA and the need for a single agency to manage the TEA process led to the establishment of the TEA Division in October 1978.

The TEA Management Agent is charged with organizing, directing, and coordinating the TRADOC TEA system. The TEA Division conducts training effectiveness analyses in partnership with proponent centers and schools and reviews TEA studies conducted independently by proponents and other TRADOC agencies or contractors. The TEA Division conducts investigations of a

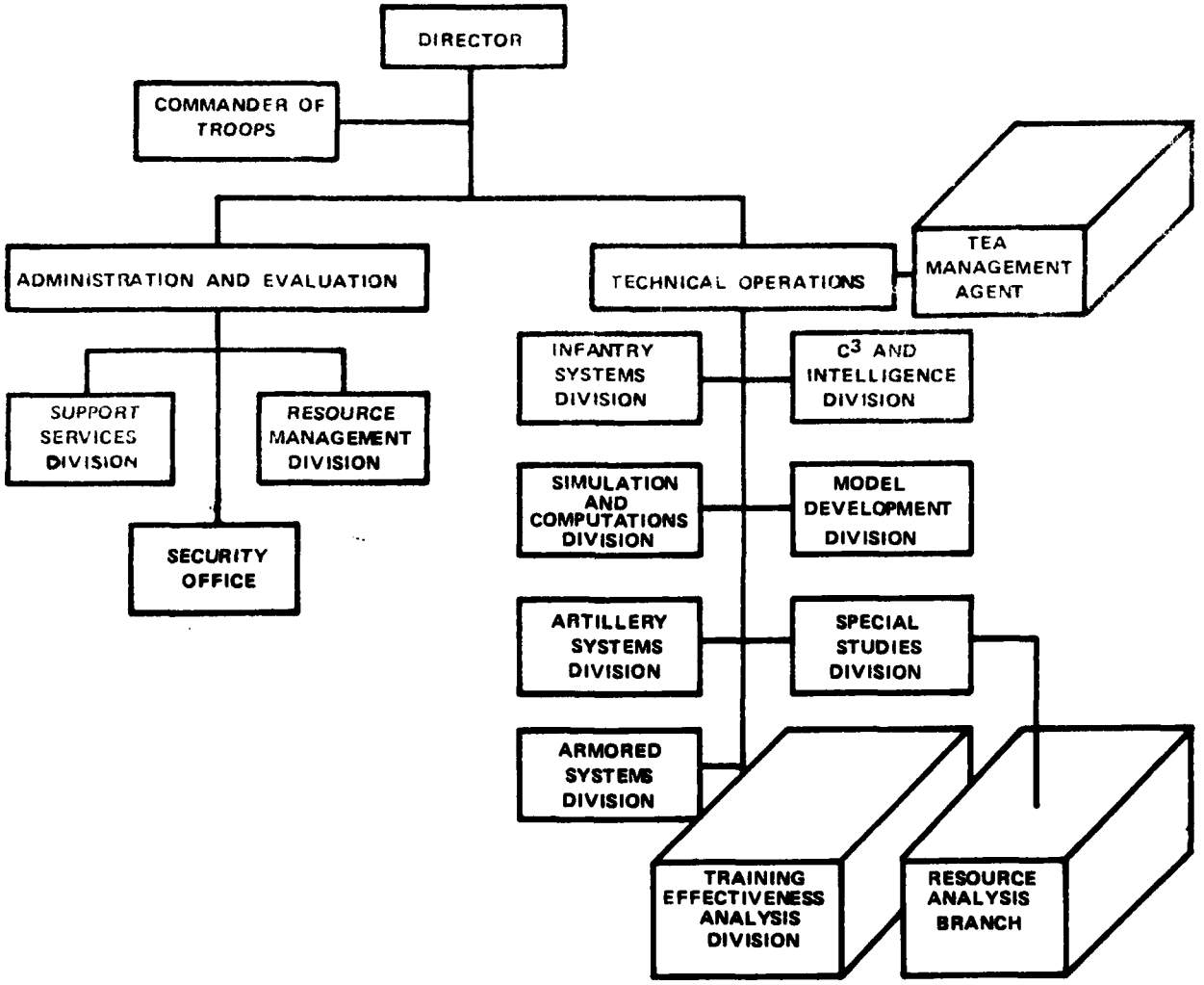


Figure 1. TRASANA Organizational Chart

variety of training subsystems. The results are provided to appropriate agencies to support decisions on developing hardware systems, modifying existing training programs, and specifying requirements for training devices. The Division is responsible for developing methods to measure effectiveness, for assuring that testing is properly designed and controlled, for developing assessment methods, and for synthesizing and interpreting the results of analyses. The Division also provides consultation to other Army agencies in the areas of training equipment, systems development and measures of training effectiveness. In summary, the TEA Division serves as a center of analytical expertise for conducting training effectiveness analyses.

STRUCTURE OF THE TEA DIVISION

Currently, the TEA division is organized into four branches. Although there is some overlap, each branch serves as the primary point of contact (POC) for certain centers and schools as shown in Figure 2.

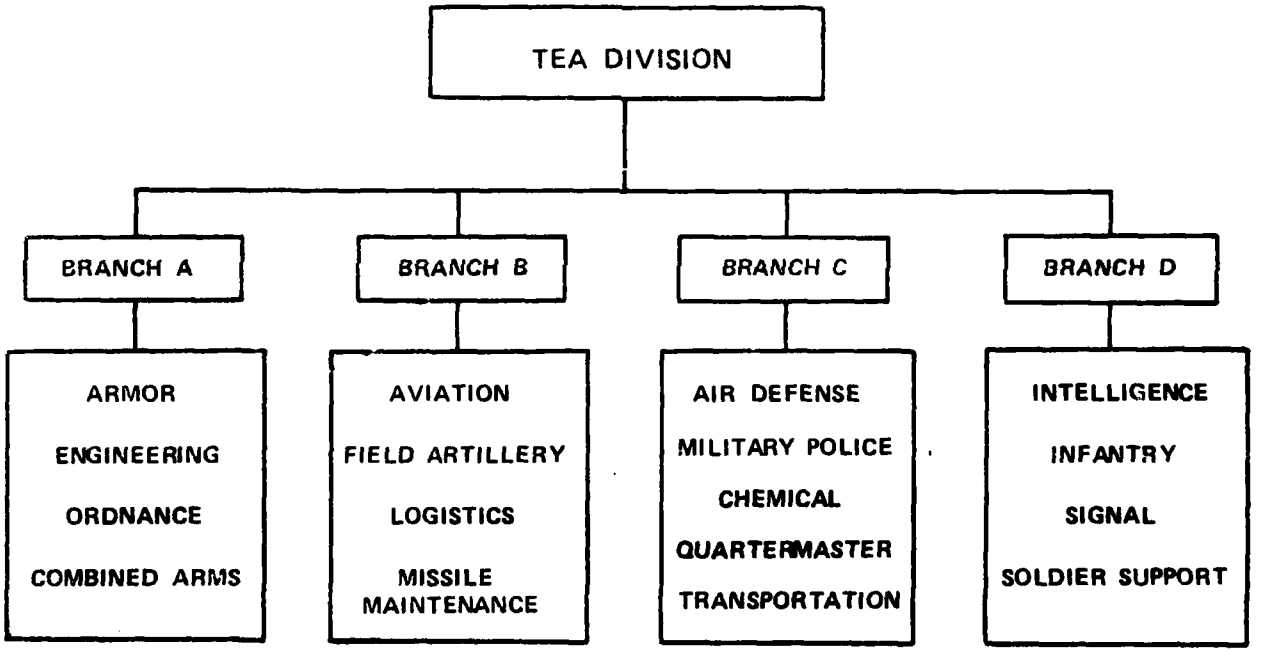


Figure 2.
TEA Division Points of Contact for TRADOC Schools and Centers

The TEA Division is an organization of people with special training and abilities. Across the four branches, the levels and areas of expertise are quite similar since the general requirements for a training analysis are similar even though the devices or systems under study may be different. Table A shows the various areas of academic specialization possessed by the members of the Division and the current number of personnel in each area at

each degree level. These figures include seven military and 38 civilian personnel. (Currently five commissioned officer slots are not filled.) The majority of the TEA technical staff have academic training in psychology, mathematics, education, engineering, and physics. The military members of the Division provide both analytical and military expertise and serve as a link between the civilian analysts and the Army.

TABLE A
NUMBER OF PERSONNEL, DEGREE LEVEL, AND AREAS OF ACADEMIC SPECIALIZATION WITHIN THE DIVISION

	Area of Specialization						
Degree	Engineering	Physics	Psychology	Education	Mathematics	[illegible]	
PhD	1		7	1	2		
MA			4	4			
MS	3	1		1	5	1	
MEd				2			
BA						1	1
BS	3	3	1	1	2	1	1
Other						1	
Total	7	4	12	9	9	4	

Each study undertaken by the Division is conducted by an interdisciplinary team made up of those individuals who possess the skills, abilities and knowledge most relevant to the problem. The team may include an analyst from the Resource Analysis Branch of the Special Studies Division. The Resource Analysis Branch provides the coordinated cost analysis which may be required for integration with the training analysis. There are thirteen Operations Research Analysts who provide cost analyses for TEA and for combat developments studies.

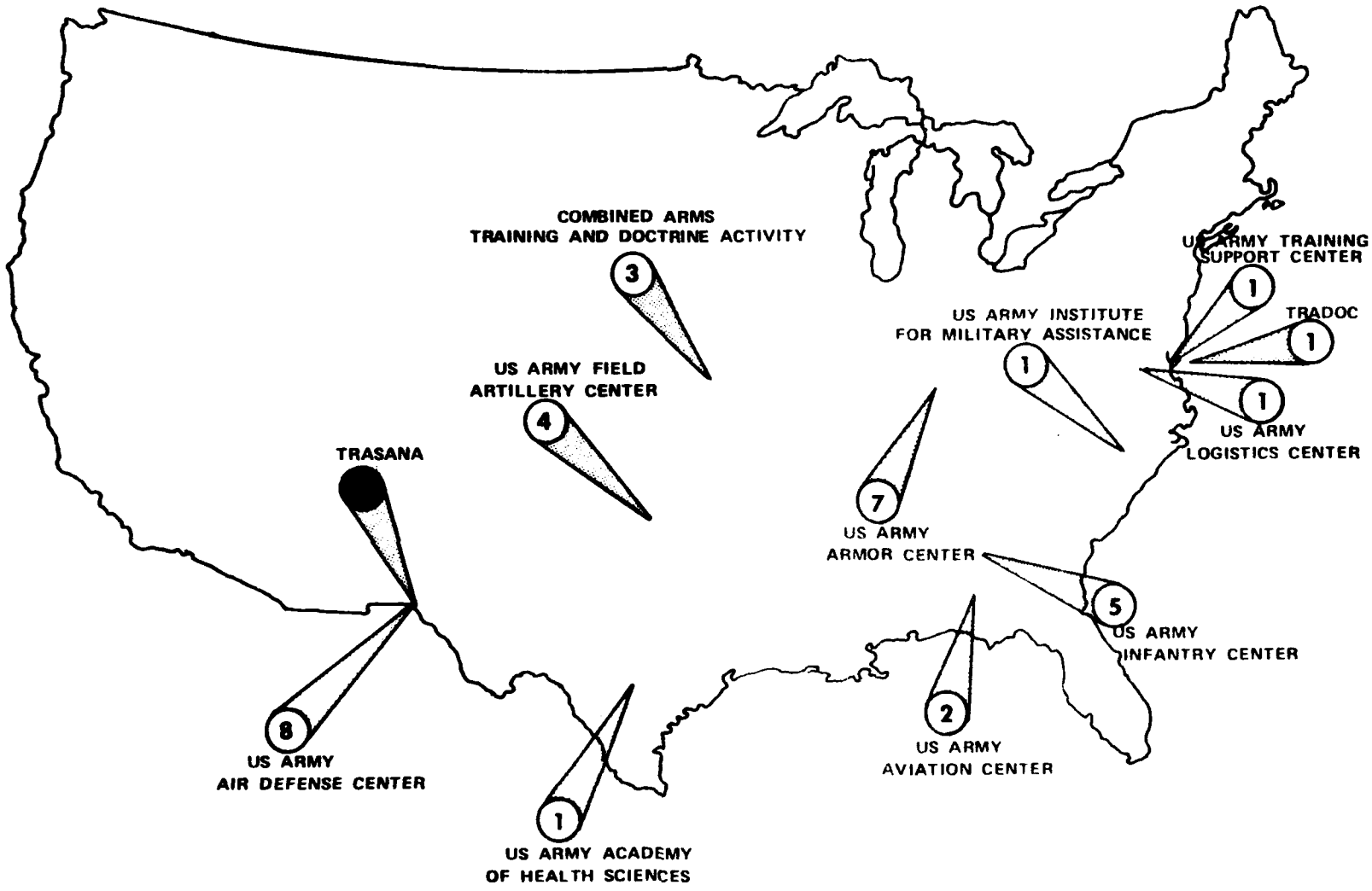
The TEA Division supports the TRADOC schools and centers (including integrating centers) and provides input to field units. The TRADOC centers and schools typically are the proponents for TEA even though the analytical results also support the field units where the data were collected. The proponents and the number of TEA completed for each as of June 1982 are shown in Figure 3. Major studies and proponents are listed in Table B, and letter reports and proponents are listed in Table C.

The TEA Division usually becomes involved in a study by one of two methods. The proponent submits a formal request for the TEA Division's assistance through the Deputy Chief of Staff for Training (DCST), TRADOC, or the proponent directly contacts the TEA Division for assistance. The Division in turn will obtain concurrence to perform the study from the DCST. In either case, the Division is usually aware of the study requirement based on a list of potential study areas maintained by the TEA Management Agent. This list is derived from several sources. Projects needed during a given time frame are the first source of information provided to the TEA Management Agent. This information is received from the TRADOC schools and centers on a recurring basis. These lists are subsequently compared to other documents containing information on potential study areas (AR 5-5, DA Designated Major or Non-major Systems). The determination to undertake a study is then based on the information available to the TEA Management Agent. Additional considerations include the resources of the TEA Division needed to accomplish the study in the time frame desired by the proponent and a subjective evaluation of the relative value of a study.

To date, the Division has conducted several different types of TEA to meet the needs of proponents. Some of these have taken a very broad approach to training analysis while others have had a more narrow focus. The scope of the study is determined by the nature of the problem. Underlying each study is a central concept which provides direction to the TEA and is applied in whole, or in part, to each TEA conducted by the Division. This central concept is that soldier proficiency, how well someone performs his or her job, is determined by five proficiency factors and their interrelationships. One or more of these factors is analyzed in each TEA.

The first factor is the individual soldier. Individuals vary along several dimensions including mental ability and aptitudes, physical ability, previous training and experience, motivation, attitudes, and perceptions. Each of these can impact on a soldier's successful completion of a training program or performance in a unit, and certain of these factors may be altered by training. For example, analysis may find that soldiers with particular aptitudes are more successful in completing a given training program. To maximize the effectiveness of the training only soldiers possessing that particular aptitude should be chosen as trainees or the training should be designed to be compatible with soldier abilities.

The second factor is the trainer or instructor. Knowledgeable, effective trainers are critical to the success of a training program. Not only must the instructor know the subject, he must also know how to teach what he knows. Equally important are his attitudes toward, and perceptions of, his role as a trainer and what is being trained. TEAs frequently include testing and/or observation of instructors and an assessment of their attitudes and opinions.



THE NUMERALS SHOW THE NUMBER OF STUDIES COMPLETED FOR THE INDICATED PROPONENT.

Figure 3. Whom Have We Supported?

TABLE B
MAJOR REPORTS COMPLETED
BY TEA DIVISION

REPORT	ABBREV*	NUMBER	DATE	PROPONENT
Basic Rifle Marksmanship Cost and Training Effectiveness Analysis (CTEA)	BRM	TR 16-77	SEP 77	USAIC
REDEYE Weapon Systems Training Effectiveness Analysis (WSTEA)	RE WSTEA	TR 21-77	NOV 77	USAADS
M60A1 Modified WSTEA	M60A1	TR 4-78	JUN 78	USAARMC
REDEYE Weapon Systems Army Training Study (ARTS)	RE ARTS	TR 6-78	OCT 78	USAADS
TEA Handbook	TEA Hbk	N/A	AUG 79	TRADOC
Marksmanship and Gunnery Laser Device/Infantry Remoted Target System Training Developments Study (TDS)	MAGLAD/ IRETS	TEA 1-79	DEC 79	USAIC
Multiple Launch Rocket System CTEA	MLRS	TEA 3-80	JUN 80	USAFAS
Infantry Fighting Vehicle Initial CTEA	IFV	TEA 4-80	MAR 80	USAIC
Patriot Air Defense System CTEA	PATRIOT	TEA 8-80	OCT 80	USAADS
VULCAN Weapons System Training Subsystem Effectiveness Analysis (TSEA)	VULCAN	TEA 23-80	OCT 80	USAADS
Cavalry Fighting Vehicle Force Development Test and Experimentation (FDTE) Training Analysis	CFV	TEA 31-80	OCT 80	USAARMC
Armor Training Test Instruments and Selection Criteria Evaluation Study TEA	ATS	TEA 38-80	JAN 81	USAARMC
Plastic Ammunition TDS Application: Military Opns in Urban Terrain	PA: MOUT	TEA 41-80	JAN 81	CATRADA
Application: 5.56mm Rifle Marksmanship Sustainment	PA: 5.56mm	TEA 41-80	JAN 81	CATRADA
Firefinder TEA Operator Selection Criterion	FIREFINDER	TEA 4-81	JAN 81	USAFAS
TDS for MOULAGES	MOULAGES	TEA 5-81	FEB 81	USAAHS
Air Defense Accessions TEA	ADA ACC	TEA 7-81	MAR 81	USAADS
Near-Term Scout Helicopter Preliminary CTEA	NTSH	TEA 10-81	APR 81	[illegible]
CHAPARRAL/REDEYE TSEA	CHAP/RE	TEA 12-81	JUN 81	[illegible]
Training Attrition Problem, Institute for Military Assistance TSEA	TAPIMA	TEA 13-81	MAR 81	USAIMA
M1 (ABRAMS) Main Battle Tank TEA	M1	TEA 37-81	SEP 81	USAARMC
Air Defense Accessions Update	ADA Update	TEA 40-81	OCT 81	USAADS
TDS M1 (ABRAMS) Tank Unit-Conduct of Fire Trainer	M1 UCOFT	TEA 11-82	MAR 82	USAARMC
Multiple Integrated Laser Engagement System Air Ground Engagement Simulation/Air Defense CTEA	MILES AGES/ AD	TEA 12-82	MAR 82	USATSC
ELSAP 2000 Tank Gunnery Turret Trainer TDS	ELSAP	TEA 13-82	MAR 82	USAARMC
M1 ABRAMS Tank Driver Trainer TDS	M1 DVR TNR	TEA 15-82	APR 82	USAARMC
PERSHING II TEA	PERSHING	TEA 17-82	MAR 82	USAFAS
UH-60 Flight Simulator TDS	UH60FS	TDS 19-82	APR 82	USAAVNC
TDS-Bradley Fighting Vehicle Unit-Conduct of Fire Trainer	FV UCOFT	TEA 28-82	MAY 82	USAIC
Corps Support Weapon System-Preliminary TEA	CSWS	TEA 23-82	JUN 82	USAFAS

*These abbreviations are used throughout the text to reference the report.

TABLE C
LETTER REPORTS COMPLETED
BY TEA DIVISION

LETTER REPORT	ABBREV*	NUMBER	DATE	PROPONENT
MOS 35H and 35B Training Course Selection Criteria	35H&35B	None	JUL 80	USALOGC
Battalion Training Model Survey	BTMS	None	OCT 80	USAARMC
Determination of Prerequisite ASVAB Scores in Air Defense MOS-Producing Courses	ASVAB LR	LR 42-81	NOV 81	USAADS
MACE CEP Training Effectiveness	MACE	LR 22-82	MAY 82	CATRADA
Infantry Remoted Target System Qualification Standards	IRETS	LR 25-82	MAY 82	USAIS

*These abbreviations are used throughout the text to reference the report.

The third factor is the training subsystem. Assessment of the training subsystem includes determining whether the program is designed to teach what the soldier needs to know, if adequate time is allowed for the different areas of instruction, if the training aids and materials are adequate and appropriate, and if the course-embedded tests are valid.

The fourth factor is the hardware subsystem. The basic question to be answered in this part of the analysis is whether the soldier is capable of doing what the hardware demands, i.e., are soldier capabilities well matched to hardware demands? Generally, this problem area is addressed by soldier/trainer questionnaires and human factor analyses of the interface between the soldier and the system. In some cases, the "hardware" may be a new training device or simulator, but the analysis is similar.

The fifth factor is the training environment. Analysis of the training environment includes assessment of how training is managed, to what extent training is emphasized, to what extent it is funded and supported, the availability of necessary supplies and equipment, and how severely and frequently training is degraded by various "distractors" (such as work details, VIP shows, faulty scheduling, and equipment malfunctions).

Figure 4 shows the interrelationships of these five proficiency factors, with Proficiency (P) centrally located in the area common to all factors. The figure suggests that with capable and willing soldiers, under the guidance of effective instructors, using a well-conceived program to train soldiers on a hardware system that can be learned in an environment relatively free of distractions, the result will be effective training and proficient soldiers. Any degradation in any of these factors can be expected to produce a concomitant degradation in training effectiveness and soldier proficiency. Whether stated explicitly or implied, this five-factor concept is the core of training effectiveness analyses.

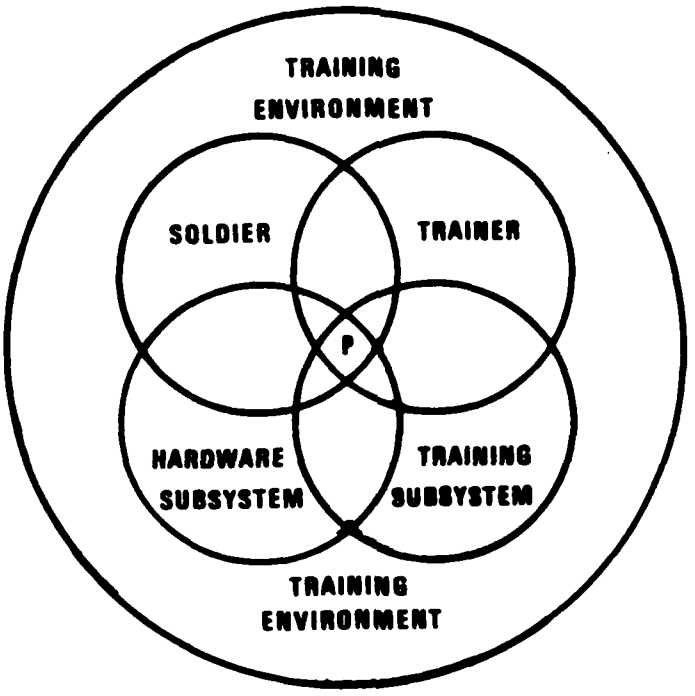


Figure 4. Interaction of the Five Proficiency Factors

WHAT HAVE WE DONE?

The studies completed by the TEA Division can be classified according to four major themes: evaluation of training, evaluation of training devices, evaluation of soldier/hardware interface, and evaluation of MOS selection criteria. Some studies may fall into more than one of these categories. Several studies include cost analysis and are presented in this section since cost is an integral part of determining efficiency.

EVALUATION OF TRAINING

The evaluation of training encompasses three separate levels: training on new equipment, institutional training, and unit training. Tables D, E, and F present the studies and the MOS training evaluated by the Division for each of the three levels.

TABLE D
TEA INCLUDING ANALYSIS OF TRAINING ON NEW EQUIPMENT

STUDY	MOS NO.	MOS
IFV	11B	Infantryman
CFV	19D	Cavalry Scout
PATRIOT	16T 24T	PATRIOT Operator PATRIOT Maintainer
M1	19K/L 45E 63E	Tank Crewmember/Tank Driver Turret Mechanic Tracked Vehicle Mechanic

TABLE E
TEA INCLUDING
ANALYSIS OF INSTITUTIONAL TRAINING

STUDY	TYPE OF INST TRNG	MOS NO.	MOS
BRM	BCT	N/A	N/A
RE WSTEA	AIT	16P	ADA Short Range Missile Crewmember
RE ARTS	AIT	16P	ADA Short Range Missile Crewmember
VULCAN	AIT	16R	ADA Short Range Gunnery Crewmember
CHAP/RE	AIT	16P	ADA Short Range Missile Crewmember
TAPIMA	Special Qual Course	N/A	N/A
PERSHING	AIT	15E	PERSHING Missile Crewmember
	PERSHING Officers Course	(SC)13C	PERSHING Officer

TABLE F
TEA INCLUDING
ANALYSIS OF UNIT TRAINING

STUDY	MOS NO.	MOS
RE WSTEA	16P	ADA Short Range Missile Crewmember
M60A1	N/A	N/A (Tank Crews)
RE ARTS	16P	ADA Short Range Missile Crewmember
VULCAN	16R	ADA Short Range Gunnery Crewmember
CHAP/RE	16P	ADA Short Range Missile Crewmember
PATRIOT	25L	AN/TSQ-73 ADA Command & Control System Operator/ Repairer
PERSHING	15E	PERSHING Missile Crewmember
	21G	PERSHING Electronics Materiel Specialist
	214E0	PERSHING Warrant Officer

EVALUATION OF TRAINING DEVICES

Training devices, including simulators, often provide efficient soldier training. An effective training device may be as expensive as actual equipment yet still be efficient. Operational and support costs associated with training devices usually are less than those of actual equipment, but initial costs may be much greater. In such cases, assessing efficiency requires a consideration of what a device or simulator is capable of training which cannot be accomplished with the actual equipment. An important device capability is fault insertion. It is seldom desirable, and usually not permitted, to "break" a tank, helicopter, or other piece of equipment so that soldiers can be trained to fix it. It is equally undesirable to create emergency situations, which may even be life-threatening, for the purposes of training. When a trainee "crashes" in a flight simulator, he may be embarrassed and feel a little "shook", but he's alive and probably much wiser from the experience. In the field, safety and range restrictions often prevent unit training on the actual weapon system, and the use of a training device is the only alternative. The development of plastic ammunition (see the PA studies) was a response to such restrictions.

Of course, there are numerous cases in which a device or simulator is not only training effective but results in significant cost savings. For example, the expense of firing live missiles and destroying target aircraft in training REDEYE soldiers is prohibitive, so training devices are required. When training devices are effective and much less costly than using the actual equipment, several devices can be acquired, thereby resulting in a greater number of soldiers being trained and/or more frequent training.

There are potential drawbacks in the use of devices and simulators which TEA analysts must assess. A soldier may become proficient at "playing the game" rather than acquiring the skills he needs for his job, i.e., knowing how to "roll up" a big score by realizing what the simulator can or cannot do. There also is the possibility of negative training transfer, or less proficient performance, as a result of a poorly designed simulator.

In summary there are three basic questions to address in evaluating training devices/simulators: (1) Can it be used to train the necessary skills?, (2) Is it cost efficient?, and (3) Are any bad habits learned? Table G lists the TEA studies which include an evaluation of training devices.

TABLE G
TEA INCLUDING AN
EVALUATION OF TRAINING DEVICE

STUDY	TRAINING DEVICE
MAGLAD/IRETS	Marksmanship and Gunnery Laser Device, Infantry Remoted Target System
CFV	Fire Control Combat Simulator (FCCS)
PATRIOT	Troop Proficiency Trainer (TPT)
VULCAN	VULCAN Training System (VTS)
P/A: MOUT	Plastic Ammunition
P/A: 5.56mm	Plastic Ammunition
MOULAGES	Moulage
CHAP/RE	AN/TSQ-T3 Monitoring Set M30 Training Missile Ground Observer Aircraft Recognition (GOAR) Kit Radio Controlled Miniature Aerial Target (RCMAT) CHAPARRAL Television Trainer
M1 UCOFT	M1 Tank Unit-Conduct of Fire Trainer
MILES AGES/AD	Multiple Integrated Laser Engagement System
ELSAP	ELSAP 2000 Tank Gunnery Turret Trainer
UH60FS	Flight Simulators--Camera Model System (CMS), Digital Image Generation (DIG)
M1 DVR TNR	M1 ABRAMS Tank Driver Trainer
FV UCOFT	BRADLEY Fighting Vehicle Unit - Conduct of Fire Trainer
IRETS	Infantry Remoted Target System
MACE	Battalion Level Wargame Simulator

EVALUATION OF SOLDIER/HARDWARE INTERFACE

The evaluation of the soldier/hardware interface is an important part of many studies, particularly TEA on new or developing systems. If a system is not operating at optimum performance levels, it is necessary to determine the extent to which the problem is due to the soldier, the hardware, or the two

in combination in the operational environment. Problems associated with the soldier may be approached by modifying the training program. Problems due to the hardware may require modifying the equipment. Although modern technology generally has simplified equipment operation, even of complex machines, equipment design deficiencies are not uncommon. Design deficiencies may adversely affect training and/or reduce soldier proficiency. This type of analysis requires the expertise of human factors engineering. Table H lists the reports which have addressed the soldier/hardware interface.

TABLE H
STUDIES ADDRESSING SOLDIER/HARDWARE INTERFACE

STUDY
IFV
MLRS
PATRIOT
VULCAN
CFV
NTSH
CHAP/RE
M1
UH60FS

EVALUATION OF SOLDIER SELECTION CRITERIA

Another major emphasis in the TEA reports is the evaluation of soldier selection criteria. For this analysis, course records are obtained from the TRADOC schools, while Armed Services Vocational Aptitude Battery (ASVAB) scores are usually obtained from the school, the Military Personnel Center (MILPERCEN) Alexandria, VA or the Defense Manpower Data Center (DMDC) Monterey, CA. Selection criteria analyses are usually required when an attrition problem is evident in an existing course. Another situation which warrants this analysis is when a new system is being developed and the necessary qualifications of soldiers to operate/maintain the system are not known. The studies analyzing the MOS selection criteria, and the MOS are shown in Table I.

COST ANALYSIS

The efficiency of a training program includes a consideration of both training effectiveness and training costs. Cost analyses may be provided as input to the evaluation of a training program for a new weapon system, in the acquisition of a simulator or training device, or when comparing two or more training alternatives with a current training program.

TABLE I
TEA INCLUDING
AN ANALYSIS OF SOLDIER SELECTION CRITERIA

STUDY	MOS NO.	MOS
MLRS	13B	Cannon Crewmember
	15D	LANCE Missile Crewmember
PATRIOT	25L	AN/TSQ-73 ADA Command and Control System Operator
ATS	19E	M48-M60A1/A3 Armor Crewmember
	19F	Tank Driver
	45N	Tank Turret Mechanic
	63C	Track Vehicle Mechanic
FIREFINDER	13E	Cannon Fire Direction Specialist
	13F	Fire Support Specialist
ADA ACC		All ADA MOS
TAPIMA	N/A	(Special Forces)
ADA Update		All ADA MOS
PERSHING	15E	PERSHING Missile Crewmember
	21G	PERSHING Electronics Materiel Specialist
ASVAB LR		All ADA MOS
35H & 35B	35H	Calibration Specialist
	35B	Electronic Instrument Repairer

Because training programs and systems must compete with other Army programs for scarce resources, many training studies are incomplete without a cost analysis. The decision as to whether a cost analysis is required should be made in the initial planning phase of the study and must be based on the issue facing the decision maker. A cost analysis probably will be necessary under the following conditions:

- o When resource requirements of any of the study alternatives are likely to be large
- o When resource requirements are likely to vary significantly among the alternatives
- o When the options available to the decision maker are likely to affect resources available to the program being studied

Table J lists the studies which include a cost analysis.

HOW DO WE DO IT?

As stated previously, training effectiveness analyses address one or more of the five proficiency factors. Essential to the process of assessment is data collection through measurement and data analyses by means of statistics. Training effectiveness analyses require many different types of measures and statistical procedures.

TABLE J
TEA INCLUDING A COST ANALYSIS

STUDY
BRM
RE ARTS
IFV
MLRS
PATRIOT
CHAP/RE
M1 DVR TRN
PA: MOUT
PA: 5.56mm
MOULAGES
M1 UCOFT
ELSAP
UH60FS

STANDARDIZED TESTS

Standardized tests are tests intended for widespread use to assess general attributes, i.e., abilities or traits possessed to some degree by virtually everyone. Standardized tests are used in TEA to determine sample representativeness, to develop selection criteria, to assess the appropriateness of training materials, and to assess soldier characteristics.

The following list shows some of the standardized tests which have been used frequently by the TEA Division and a brief statement of the purpose of each test.

- Select Adult Basic Learning Exam (SelectABLE) -- Measure word and number knowledge; estimate Reading Grade Level (RGL).
- Gates MacGinitie Reading Test -- Measure reading vocabulary, comprehension and RGL.
- Lynn Achievement Motivation Scale (Lynn) -- Compare achievement motivation among groups.
- Armed Services Vocational Aptitude Battery (ASVAB) -- Measures of general aptitude areas which are related to certain military occupational fields. These aptitude areas (composites) are:

  General Technical (GT)
  General Maintenance (GM)
  Electronics Repair (EL)
  Combat (CO)
  Mechanical Maintenance (MM)
  Field Artillery (FA)
  Operators and Food (OF)
  Skilled Technical (ST)
  Clerical (CL)
  Surveillance & Communications (SC)

- o Armed Forces Qualification Test Percentile Score (AFQT) -- A broad measure of intellectual ability.

Listing 1 is a reference of reports in which these specific tests were used and is provided at the conclusion of this report.

SPECIAL PURPOSE TESTS

In addition to standardized tests, it is frequently necessary for the analysts to develop special purpose tests and surveys to answer specific questions posed in a particular study. Two types of special purpose tests are used frequently in the TEA process: written proficiency tests, also called skills and knowledge (S/K) tests; and performance proficiency tests, better known as hands-on tests (HOT).

Written proficiency tests are used to assess the soldier's knowledge and understanding of what he has been taught. They are particularly useful for evaluating the depth of a soldier's understanding and for testing his knowledge of how to do something. Written proficiency tests typically are paper-and-pencil tests with a multiple-choice, true-false, and/or short answer format. The majority of the studies in the TEA Division have included a written proficiency test (see Listing 2).

Performance proficiency tests require a soldier to actually perform tasks he was trained to do. The test may be comprehensive, i.e., include all tasks trained or may consist of selected representative tasks. Performance profi-ciency tests are often scored on a "Go or No-Go" basis. Either the soldier performs the task correctly or he does not. The score is assigned by the test administrator who may be a TEA analyst, an instructor, or another trained data collector.

Written and performance proficiency tests provide the most direct and objective data by which a training program can be evaluated and serve as the primary measures of training effectiveness (MOTE). For the most part, proficiency tests are developed (with the assistance of subject matter experts), administered, scored, and interpreted by analysts of the TEA Division.

SPECIAL PURPOSE SURVEYS

In addition to performance tests, soldier and trainer attitudes and perceptions also provide useful information in the TEA process. Typically, these data are obtained by various types of surveys. These surveys address general attitudes and/or specific attitudes toward hardware and training.

General attitudes are assessed for a number of reasons. They serve as useful indicators of general motivation and can be used to control for differences in training and proficiency resulting from motivation and general outlook on training, the Army, and particular weapon systems. While attitudes do not necessarily correlate directly with measured proficiency,

they do offer important and useful insights into the interpretation of proficiency scores and results of training. When carefully measured and interpreted, they serve as a valuable "temperature check" on morale and motivation.

The usual procedure of attitude assessment is to have the soldier indicate the extent to which he agrees or disagrees with a particular statement. The most frequent areas of general attitude assessment are attitudes toward the United States, the Army, peers, superiors, and the soldier's unit. In addition, assessment is made of more specific attitudes toward training, trainers, and hardware. Listing 3 shows the studies which included general attitude surveys.

Another frequently used survey is an assessment of soldier perceptions of the tasks related to his job. It is important to determine which tasks are the most important to the successful completion of a job or mission and whether these critical tasks receive corresponding emphasis in training. To determine the extent to which training addresses actual job requirements, several TEA have included a "Task Frequency, Criticality, and Performance Survey" (which may be expanded to include perceptions of task difficulty and task training requirements). Constructing these surveys may be difficult for a developing system because task lists often are not available. The studies including these surveys are in Listing 4 at the end of the report.

Another source of information in TEA is demographic surveys which yield background and descriptive information on the study participants, e.g., age, rank, educational level, and MOS. This information is used to describe the test subjects, determine if the sample is representative, and determine if demographic information is related to performance measures. Another use of demographic information is to compare two or more study groups to insure their approximate equivalence in terms of performance related variables.

ADDITIONAL PROCEDURES AND ANALYSES IN TEA

There are still other procedures and analyses used in certain studies other than the tests and surveys discussed above. In some instances, (see studies indicated in Table K), it is possible to carry out force-on-force simulations in which observed proficiency, usually as a result of training, is put into a computer model of a simulated combat engagement. The results of the simulation approximate actual combat outcomes given the measured effectiveness of the training program.

Many TEA include human factors analyses. Observations are made as to where the soldier-weapon interface presents problems. For example, it was noted in the REDEYE WSTEA study that soldiers were required to memorize a matrix of 28 numbers to successfully engage a target. Subsequent to the TEA, the matrix was revised and made simpler to apply. Such observations, with recommended improvements, are quite common in the TEA process.

TABLE K
STUDIES INCLUDING FORCE-ON-FORCE SIMULATIONS

STUDY
RE WSTEA M60A1 RE ARTS IRETS

COST ANALYSIS

The cost analysis associated with a TEA is aimed at the evaluation of economic considerations on which decisions will be made. It typically follows the same analytical process that is inherent in any cost analysis. The costing approach is conceptually and methodologically similar to the approach normally undertaken for Cost and Operational Effectiveness Analysis (COEA). The procedure for a cost analysis is as follows:

- o Define objective
- o Define alternatives
- o Formulate assumptions
- o Develop methodology for estimating cost
- o Determine quantities costs
- o Perform detailed analysis
- o Analyze uncertainties
- o Write report

The difference between the TEA and COEA approach is that the TEA focuses on the training subsystem, while the COEA treats the entire materiel system. The total life cycle costs of alternative training subsystems are required to establish a relative cost relationship. This total cost is composed of two elements - The cost of acquisition (nonrecurring) and cost of ownership

(recurring) with ownership cost being the sum of all operating and support costs. Therefore, the analyst must:

- o Distinguish between recurring and nonrecurring costs
- o Insure that the costs of the base case and each alternative are fully captured and evaluated
- o Insure that all costs of system support are included
- o Display total costs in such a manner as to allow valid comparison of alternatives

STATISTICS

TEA require collection of several different types of data, including demographic information, proficiency tests, attitude surveys, questionnaires, simulation outcomes, human factors analyses, and cost analyses. Once compiled, these data must be organized and statistically evaluated. The various statistical procedures used in TEA for evaluating differences between groups and determining the extent to which two or more variables are related are shown in Listings 5 and 6. Exactly which procedure is used is determined by the question to be answered and the nature of the data.

WHAT HAVE WE LEARNED ABOUT TRAINING EFFECTIVENESS?

The Army's approach to training is based on sound concepts, and a concentrated effort to apply these concepts is evident. The Instructional System Development (ISD) procedure and the use of criterion referenced tests are good examples of the Army's attempt to maximize training effectiveness. In fact, the existence of the TEA Division and the requirement for training effectiveness analyses are evidence of the Army's commitment to develop quality training systems.

Since a primary purpose of the TEA process is to optimize training effectiveness and prevent training deficiencies, this section of the report focuses on problem areas that have surfaced in TEA projects to date. These problems are discussed in terms of the five proficiency factors presented in the section "What Do We Do?". The Division has looked at several training systems, devices, and MOS. Some trends have emerged across the various studies.

THE SOLDIER

In several studies soldier's attributes were found to be directly related to proficiency. Army soldiers possess generally positive attitudes. They want to learn, take pride in their units and work, and are motivated to do a good job.

Soldiers' attitudes occasionally have been correlated with performance and have proven a valuable source of general information on training and hardware subsystems. Less-than-positive attitudes may result from how training is conducted (as in the TAPIMA study), equipment malfunctions (MILES AGES/AD), and equipment nonavailability (PATRIOT). In addition to thinking of how training affects individual attitudes, the effects of collective negative attitudes on the success of a training program and morale in general also need to be considered.

THE TRAINER

In TEA where the effectiveness of the trainer was addressed, it was found that most trainers are qualified. Some instructor-related problems at AIT and in the units have been documented. Unit trainers are often transferred from one system to another, with no formal training on the new system (CHAP/RE and PERSHING studies). One study found instructors to be knowledgeable in the subject matter, but several were unskilled in "how to train".

In the M1 DVR TNR report, it was found that none of the six contractor trained instructors passed a performance proficiency test. In other words, they could not perform the tasks required to operate the training device. Due to frequent equipment malfunctions, it could not be determined whether their inability to perform the tasks was due to a training problem or an equipment problem. Fortunately, there was time for additional instructor training and equipment repairs before the course began.

Not all trainer problems are related to instructor qualifications. It is a common occurrence that the student-to-instructor ratio exceeds that specified for the course (see the CHAP/RE and FIREFINDER reports). In the CHAP/RE study, the student-instructor ratio was 18 to 1. The number of authorized instructors was 35, but only 15 were assigned and even fewer were present for duty. In such cases, the number of instructors, not the quality, is a major problem.

THE TRAINING SUBSYSTEM

To evaluate a training program, what the trainee is expected to learn and the desired level of proficiency must be known. This requires developing a list of tasks to be trained and the expected performance standards for each task. A common source of task lists is the soldier's manual (SM) which specifies the critical tasks, conditions, and performance standards at each skill level for each MOS.

In the ATS study, it was found that the program of instruction (POI) did not correspond to the SM task list. A similar discrepancy between the POI and SM was found in the M1 study of new equipment training (NET). An additional finding of the M1 study was that the results of course-embedded tests were not an accurate reflection of soldier proficiency, i.e., the tests lacked validity.

Although not consistent across all studies, numerous other problems related to training subsystems have been found, including:

- o Insufficient "hands-on" training
- o Too much emphasis on administrative, or "irrelevant", training
- o Lack of individual attention given the trainee
- o Unnecessary stress placed on trainees during skill-acquisition phase of training
- o Unrealistic training (reduced firing ranges or insufficient number of targets presented as in the M60A1 report)
- o Failure to adhere to the ISD model
- o Insufficient training time
- o Failure to adhere to the requirements of a training program
- o Insufficient testing within a POI (CFV, M1, ATS)
- o Inappropriately written course material for reading ability of soldiers

Perhaps the most significant general problem related to training is the nonstandardized unit training. Consider this synopsis of unit training:

> "Unit training programs are sporadic, ineffective, and are generally characterized by high expenditure of limited resources without an appreciable increase in mission capability and/or individual skills." - NTSH PTEA, April 81.

For those units evaluated in the TEA reports, nonstandardized unit training seemed to be widespread (RE ARTS, VULCAN, CHAP/RE, NTSH, PERSHING). Units may fail to adhere to training schedules or lack an organized training schedule altogether. Most unit training is test-directed, i.e., occurs in preparation for some evaluation exercise. The standards and objectives of the various tests may be inconsistent and sometimes conflicting with each other. Command emphasis is often oriented toward training to pass the next test and not necessarily toward complete, well-balanced training. These problems are prevalent in the Army and have a marked impact on the effectiveness of unit training.

It has been documented (PATRIOT) that more training does not improve proficiency when the training is inadequate or poor. "Practice makes perfect" only when the practice is carefully planned and supervised to yield a specific result. More training is not necessarily the answer, better training is.

THE HARDWARE SUBSYSTEM

Problems with equipment are evident in many of the TEA. These problems include equipment malfunctions and nonavailability. Reference to Table L gives an overall view of the types of problems found and how these problems impact on training. Maintenance problems occur most often with new equipment because all of the "bugs" have not been worked out and maintenance personnel have not been fully trained. For fielded systems, the problems usually result from a lack of repair parts, maintenance equipment, and/or maintenance personnel.

TABLE L
STUDIES IN WHICH HARDWARE PROBLEMS
OCCURRED WITH MAJOR IMPACT ON TRAINING

STUDY	PROBLEM
RE ARTS	Lack of missiles for live firing; insufficient number of facilities and devices to support necessary training
PATRIOT	Major maintenance problems; lack of software
CFV	Target devices malfunctioned
VULCAN	Lack of maintenance equipment; equipment failures; no mounting brackets for training device
CHAP/RE	Lack of maintenance personnel and repair parts; insufficient number of training missiles
MILES AGES/AD	MILES equipment malfunctions caused loss of training time and confidence in system
MAGLAD/IRETS	Range malfunctions
IFV	Nightsight malfunction
PA: 5.56mm	Weapon malfunctions degraded training
M1	Equipment inoperable

Hardware problems also are related to design deficiencies. In the VULCAN study, the equipment design was found to oppose the soldier's natural tendency to correct for lag in tracking a target. In the M1 DVR TNR study, the steering indicator was ineffective in providing proper feedback to the trainee. In the MLRS report, the requirement for the trainee to translate alphanumeric codes significantly increased mission time. These are problems in the area of human factors engineering and suggest greater attention should be given to the soldier-hardware interface.

THE TRAINING ENVIRONMENT

Problems associated with the training environment are numerous and varied. Too often, training is disrupted by work details or putting the soldier in a support role, putting on VIP shows, or similar training distractors. Training facilities often are inadequate. This includes crowded classrooms and poor environmental conditions (lack of air conditioning as noted in the CHAP/RE study and using the rear tank deck for training as described in the M1 study). Particularly in Europe, adequate training areas are limited (RE ARTS, CHAP/RE, PA: MOUT, PA: 5.56mm) and areas for live fire training are restricted. A different type of problem was noted in the NTSH report. Pilots knew the military reservation over which they trained so well that the training was "artificial" and contributed little to increasing their proficiency.

To summarize, problem areas are not consistent across all studies, but the problems are numerous. Certain problems must be tolerated to some extent (e.g., resource and cost constraints). Other problems, especially the low quality of training, could be prevented or overcome by better planning from lessons learned and a greater appreciation of the importance of a well-trained and highly proficient Army.

WHAT HAVE WE LEARNED ABOUT CONDUCTING EVALUATIONS?

The TEA Division has learned many lessons as a result of the development of TEA methods and additional expertise and manpower. In addition, the TEA analysts have learned that certain events may occur that cannot be prevented. Both of these areas are presented here because of their impact on conducting evaluations.

LESSONS LEARNED

The major lessons learned by the Division can be categorized in the following areas:

- o Coordinating a project
- o Obtaining data
- o Data analysis
- o Feedback to the Army

Coordinating a Project

The experience the TEA analysts have gained over the past four years is evident in the initial stages of a TEA. TEA analysts now realize what can or cannot be done when planning a project. Sometimes a project may not be undertaken by the Division because what is proposed by a proponent is not

feasible. TEA analysts relying on accumulated experience have thereby avoided committing valuable resources to TEA efforts destined to be plagued with problems and unlikely to yield useful information.

The experience and expertise of the TEA personnel also have resulted in more realistic resource estimates and answerable objectives for studies which are undertaken. The documents containing these estimates and objectives (Project Coordination Sheet, Project Plan and Study Plan) are more detailed, accurate, and relevant.

Additionally, the TEA analysts have become more sensitive to the depth of the study requirement made by the proponent. The more intensive the TEA, the more manpower needed to accomplish the objectives. The Division expends 3-5 man years to complete most major TEA.

Obtaining Data

In many TEA, it is necessary to obtain background data, course records, and standardized test scores from other Army agencies. The personal contacts made with the proponents, MILPERCEN, and DMDC have improved the acquisition of these data. Personnel of the TEA Division realize what data are needed, where they can be obtained, and the approximate length of time required to receive the data. These lessons have proven very beneficial in estimating cost and manpower for a project and in the execution of the TEA by allowing the obtained data to be related to the results of tests and surveys administered by the Division. TEA projects now bring together a wealth of information from various sources. The result is a more thorough and accurate picture of Army training.

Data Analysis

With the added expertise of mathematicians, statisticians, and computer scientists, data analysis plans now are more detailed, and full advantage is made of the UNIVAC 1100/82 computer. Analysts frequently use the package programs available on the computer, particularly those of the Statistical Package for the Social Sciences (SPSS) and the Biomedical Computer Programs (BMDP). Large amounts of data are now analyzed in a shorter period of time with a great savings in manpower. The SPSS and BMDP packages not only include the more common parametric statistical tests but also most of the nonparametric procedures for analyzing data from nominal and ordinal measurement and/or small samples.

Feedback to the Army

It is TEA Division policy to brief the results of studies to the proponents and to the tactical field units where the data were collected. The briefing to the proponent is the first presentation of the results of the TEA. For the field units, these briefings provide feedback on training deficiencies and other findings of the study. From this information, the unit commander can identify strengths and weaknesses of the unit training programs. For the Division, the result of these briefings is to increase the visibility of the TEA process.

TRADOC schools and centers which have not been briefed on the TEA process or a TEA study are encouraged to request a formal presentation. These briefings are an integral part of the TEA process and provide a means of presenting TEA results in a clear, concise, and interesting manner.

EVENTS/PROBLEMS ENCOUNTERED IN CONDUCTING EVALUATIONS

In the conduct of TEA certain problems have been encountered which are beyond the control of the analysts. These problems are documented here to provide the newcomer to the TEA process an overview of possible pitfalls in accomplishing a TEA. These problems are specifically related to:

- o Samples
- o Scheduling
- o Collecting data on a non-interfering basis
- o Incompleteness of data
- o Resource constraints

Ideally, the hope of any analyst is to obtain a representative sample of adequate size. Sample size depends on the developmental phase of the system under study, availability of the appropriate soldiers, and cost of collecting data (e.g., travel costs). The impact of a study is often dependent on which and how many soldiers were participants.

It is often difficult to adhere to data collection schedules and conditions. Soldiers often will not be available at the requested time. When scheduling data collection activities, especially hands-on tests, more than one day should be set aside for the personnel and equipment to be available for testing. In reality, this is rarely possible. The one day scheduled for the test will probably be the only day the test soldiers will be available. If something happens on that day to degrade the results (see the MAGLAD/IRETS and M1 UCOFT reports), the choice is to "live with it" and interpret the results accordingly or not complete the project.

In several of the TEA studies (IFV, PATRIOT, PERSHING, MLRS), the Division analysts agreed to collect data on a non-interfering basis, i.e., without interrupting the ongoing activities of a unit or training program. This sometimes results in performing subjective evaluations, or "educated guesses", about performance. In the NTSH project, timely and adequate access to base case hardware and alternatives was not given.

The first source of incomplete information is associated with data collected from other sources. Course records often do not include specific reasons for a soldier failing to graduate from a class. Standardized scores and demographic data obtained from the school and other sources often are incomplete or only in summary form which limits usefulness. In some instances, no records are available for certain individuals.

The second source of incomplete information is related to equipment malfunctions or design problems. Data collection efforts may be delayed because of maintenance difficulties. During the CFV study, one target device malfunctioned and another had to be substituted. This type of problem causes the test plan to be altered and data collection to be delayed. The UH60FS TDS was delayed for over six months due to temperature and humidity effects on the computers. In the PATRIOT study, the print-out score from the Troop Proficiency Trainer (TPT) was found to be an inaccurate reflection of soldier performance. In the ELSAP project, performance proficiency tests were not possible because the Swiss Army could not provide a tank as planned. These types of problems often will be encountered when relying on equipment to provide assessment data. Similar kinds of problems develop when analysts must use unapproved task lists as in new equipment training evaluations. The results of the TEA may be limited when the approved task list is published. Often, the Division must compare a system to conceptual alternatives that do not exist in the real world.

There are certain instances in which the Division requests specific samples, dates for collecting data, cost information, or equipment, and these requests are not met. The reasons for not meeting these requests often are associated with the proponent's mission requirements, inability to comply because of deadlines to be met, or the cost of fulfilling a request. Since certain objectives of the TEA are dependent on these requests being met, it may be necessary to renegotiate a Study Plan, Project Plan, or Project Coordination Sheet. It may happen that these problems are not known until the study is nearly completed. Because of resource and schedule limitations external to the Division and commitments to other proponents, the study will be completed, and the reasons for not meeting certain objectives will be documented in the report.

The lessons learned by the Division provide a firm foundation for future development of the TEA process. As a result of past efforts, Division analysts are better able to recognize what information is required for a particular study and anticipate the nature and impact of problems likely to be encountered in collecting that information. Division analysts have become more highly skilled in obtaining and analyzing data. As the TEA process grows and develops, it will be necessary to build on what has been learned. The continued evolution of TEA methodology requires further research, refinement of test development procedures, and adoption of more sophisticated analytical techniques. The methods and procedures which have served well in the past may need to be improved in the future.

WHERE ARE WE HEADED?

When established in 1978, the goals of the Division were to:

- Contribute to the fielding of optimum training packages with the hardware
- Assist in the improvement of existing training packages
- Build a TEA data base

These remain the primary goals of the Division today. However, special emphases within these goals have developed as a result of the added experience of the Division and changes in Army structure and organization. These emphases include:

- o Army Force Modernization
  - oo Conducting more TEA on post-fielded systems
  - oo Conducting TEA early in the developmental phase
- o Permeation of the TEA process throughout the Army

The future directions of the TEA process will be strongly influenced by the Division's attempt to meet these objectives.

ARMY FORCE MODERNIZATION

Development of TEA Procedures for Post-Fielded Systems

Currently, the Division is fine-tuning TEA procedures for post-fielded systems which will allow more immediate feedback to unit commanders. The focus of these TEA will be on soldier proficiency in those tasks and functions essential to success in combat. To accelerate the TEA process, the analytical procedures will be less sophisticated statistically, more subjective in nature, and rely more on existing test instruments than full-scale TEA. Although more narrow in scope than major long-term studies, these TEA will include hands-on tests, skills and knowledge tests, assessment of soldier's attitudes toward training, and examination of SQT results and unit evaluation exercises. The result of such limited-scope TEAs will be more general in nature than detailed studies and will focus on broad issues and yield trends and hypotheses that will help identify systems requiring more in-depth analysis.

To support an increase in post-fielded system analyses, the Division has proposed that a TEA cell be established in Europe. The cell would allow the TEA analysts to be "on-site" with units stationed in Europe. The result would be more timely analyses tailored to the specific training needs of individual units in their operational environment.

Completing TEAs Early in the Developmental Phase

The impact of force modernization will be widespread and include the TEA Division. TEA will have to be conducted very early in the developmental phases of new equipment, perhaps even during the conceptual phase, to insure the most efficient systems are fielded.

The Division has already become involved in force modernization problems with the "Corps Support Weapon System (CSWS) Preliminary TEA." The TEA compared five alternatives which have been proposed to serve as the corps support weapon system. The comparison included personnel resource

requirements, training support requirements, behavioral requirements of equipment-related tasks, and soldier perceptions of training adequacy. Since only two of the alternatives have been fielded, certain aspects of the comparison were conceptual.

The CSWS study is important because it is the first TEA conducted by the Division on conceptual systems. Another evaluation of a conceptual system, the Direct Support Automatic Test Support System, is already underway. Evaluations of conceptual systems will provide valuable information to system contractors, combat force developers and training developers about system requirements in the areas of personnel, training, and equipment design.

PERMEATION OF THE TEA PROCESS

The TEA Management Agent is charged with promoting the TEA process throughout TRADOC and the Army. To date, studies have been completed for eleven different TRADOC schools and centers. Additional studies are presently underway, including some for proponents which have not previously requested a TEA. Any TRADOC school or center which has not requested the Division's assistance is encouraged to do so. The Division hopes to make the TEA process an integral part of all Army training.

In an effort to promote the TEA process, the TEA methodology will be updated. Specific ideas about the conduct of TEAs have been proposed since the draft TEA Handbook was published in 1979. This handbook gave only general guidelines to accomplish a CTEA. A pamphlet will be produced in the future updating this CTEA methodology. In addition, the handbook will also be revised. Both of these documents should prove beneficial to TEA analysts and to proponents.

The TEA Division will assist the TEA Management Agent in conducting seminars in TEA procedures as yet another means of promoting the TEA process. The first seminar, "Introduction to Training Effectiveness Analysis (TEA)," was held 20 September through 1 October 1982, at the US Army Air Defense Center, Fort Bliss, Texas. The course was directed toward military and civilian action officers whose duties require them to supervise, plan, conduct, monitor, and/or review TEA studies. The seminar emphasized TEA policies, philosophy, principles, processes, and methods. The training focused on the "how to" aspects of the TEA process and the rationale underlying TEA methods. The course provided the action officer an opportunity to expand his or her abilities with subsequent on-the-job application of the TEA process, TEA study experience, and additional professional training to become a fully qualified TEA action officer.

SUMMARY

In reviewing the activities of the TEA Management Agent and the TEA Division since its inception, it is obvious that much has been done and much has been learned. Over thirty major studies have been accomplished in support of eleven different proponents. These studies have covered a wide array of topics, from the evaluation of tanks to flight simulators, from rifles to missiles. The results of these studies have contributed to decisions on whether a system should be fielded, how training programs should be conducted, how trainees should be selected, and how equipment should be designed to maximize soldier proficiency. Deficiencies in Army training have been identified and solutions recommended.

In the process of evaluating training programs, the methods and techniques of the analysis process itself have been evaluated. As a result, training effectiveness analytical procedures are being modified to insure the data collected are reliable, valid, and properly analyzed and interpreted.

In the next few years, new demands will be placed on the TEA process as the Army modernizes its forces and as more proponents request assistance from the Division. To meet these demands, the TEA process must be continuously reviewed and modified as required. It must remain a process in evolution.

LISTING 1
SOME STANDARDIZED TESTS WHICH HAVE
BEEN USED IN THE TEA DIVISION'S REPORTS

STUDY	AFQT	ASVAB COMPOSITES										SELECTABLE	GATES MACGINITIE	LYNN
		GT	GM	EL	CO	MM	SC	FA	OF	ST	CL			
BRM		X	X	X	X	X	X	X	X	X	X			
RE WSTEA	X	X							X					
RE ARTS	X	X						X	X					
MAGLAD/IRETS														X
MLRS	X	X						X	X			X		X
IFV	X	X										X		
PATRIOT	X	X	X	X	X	X	X	X	X	X	X	X		X
VULCAN	X	X							X			X		X
CFV	X	X	X	X	X	X	X	X	X	X	X	X		X
ATS	X	X	X	X	X	X	X	X	X	X	X			
P/A:5.56mm														X
FIREFINDER	X	X	X	X	X	X	X	X	X	X	X	X		X
ADA ACC	X	X	X	X	X	X	X	X	X	X	X	X	X	
NTSH	X	X	X	X	X	X	X	X	X	X	X			
CHAP/RE	X	X							X			X		
TAPIMA	X	X	X	X	X	X	X	X	X	X	X		X	
M1	X	X	X	X	X	X	X	X	X	X	X	X		
ADA UPDATE	X	X	X	X	X	X	X	X	X	X	X	X	X	
M1 UCOFT	X	X	X	X	X	X	X	X	X	X	X			
ELSAP	X	X	X	X	X	X	X	X	X	X	X	X		X
PERSHING	X	X	X	X	X	X	X	X	X	X	X		X	
M1 DVR TNR	X	X	X	X	X	X	X	X	X	X	X	X		X
CSWS	X	X	X	X	X	X	X	X	X	X	X			
35H&35B	X	X	X	X	X	X	X	X	X	X	X			
BTMS														
ASVAB LR	X	X	X	X	X	X	X	X	X	X	X			

LISTING 2
STUDIES INCLUDING A
S/K TEST DEVELOPED BY TEA DIVISION

Study	Soldiers	Number of items	Percent of Items Answered Correctly
RE WSTEA	16P-UNIT 16P-AIT	18 (3 resp each)	Units, range 22% to 37%; USAREUR - 34%; AIT - 30%
RE ARTS	16P-UNIT 16P-AIT	18 (3 resp each)	Units, range 21% to 47%; USAREUR - 40% AIT - 26%
MLRS (Phase II)	13B and 15D	System A-39 System B-40	System A - 13B - 95% 15D - 88% System B - 13B - 90% 15D - 96%
PATRIOT	Operators Maint	119-PRE 116-POST 90	Operators - 55% PRE 59% POST Maint - 63% PRE 67% POST
VULCAN	16P	25	AIT - 84%; UNIT - 68%
CFV	Tank Crews	40-44	68%-70% across three tests
PA: MOUT		10	PA group - 58% Blank group - 63%
PA: 5.56mm		10	No means given
FIREFINDER		25	Range 40% to 92%
CHAP/RE	CHAP	46-OSUT 60-UNITS	OSUT - By Task, Range 16% to 64%; UNITS, OCONUS - 46% CONUS - 43%
	REDEYE	18 (3 resp each)	Range 48% to 65%; USAREUR - 60%

Listing 2 (Continued)

Study	Soldiers	Numbers of Items	Percent of Items Answered Correctly
M1	19 K/L	40	19 K/L - 66%
	45E	40	45E - 65%
	63E	40	63E - 68%
M1 UCOFT	UCOFT	40	Baseline - PRE 79%, POST 82%; UCOFT - PRE 80%, POST 81%; Transition - 76%
		90	Baseline - PRE 89%, POST 85%; UCOFT - PRE 92%, POST 88%
M1 DVR TRN	CREW	40	58%
PERSHING	15E	150	MOS 15E: Skill Level 1 - 65%; Skill Level 2 - 70%; Skill Level 3 - 78%; Skill Level 4 - 76%; AIT-74%
	21G	63	74%
	214E0	69	71%
FV UCOFT		20	FV - 65% UCOFT - 66%

LISTING 3
STUDIES INCLUDING GENERAL ATTITUDE SURVEYS

STUDY	ITEMS	ATTITUDES
RE WSTEA	29	Attitude toward the service, motivation, leadership, discipline
	17	Attitude toward: military assignments, peers, section functioning as group, immediate supervisors
RE ARTS	29, 17	(Same as REDEYE WSTEA)
MAGLAD/IRETS	25	None
MLRS	26	Morale, Army training specific
IFV	114	None
PATRIOT	98	Attitude toward: US Army, unit officers, supervisors, training, PATRIOT, morale
	96	(AN/TSQ-73) Attitude toward: US, Army, unit officers, superiors, training, AN/TSQ-73
VULCAN	114 (UNIT)	Attitude toward: Army, platoon leader, platoon sergeant, squad, unit, training NCO, AIT/BCT, US
	100 (AIT)	Attitude toward: AIT instructor, BCT/AIT, drill sergeant, Army, unit officers, US, unit
CFV	60	Attitude toward: Army, Platoon sergeant, platoon leader, squad, training NCOs, AIT/BCT, unit, US
FIREFINDER	38	Attitude toward: training officer leadership, drill sergeant leadership, Army, US
CHAP/RE	66	None
	15 (OSUT)	None
	17 (REDEYE)	None
M1	60	Attitude toward: Army, platoon sergeant, platoon leader, peers, training, hardware
M1 UCOFT	50	Attitude toward: Army, platoon sergeant, platoon leader, peers, M1, training
ELSAP	47	Attitude toward: Army, peers, supervisors
PERSHING	46	Attitude toward: Army, PIa, PII, transition of PIa to PII, AIT, unit training, nuclear weapons, prime movers
UH60FS	43	Attitude toward: Army aviation as career, flight simulators, UH-60A helicopter

LISTING 4
STUDIES INCLUDING TASK SURVEYS

STUDY	ASPECTS OF TASK MEASURED					
	FREQUENCY	CRITICALITY	PERFORMANCE	AMOUNT OF TRAINING	DIFFICULTY	QUALITY OF INSTRUCTION
RE WSTEA		X		X	X	X
RE ARTS		X		X	X	X
MAGLAD/IRETS		X		X		
IFV	X	X	X			
PATRIOT	X	X	X	X	X	
CFV	X	X	X			
PA: MOUT	X	X	X			
PA: 5.56mm	X	X	X			
NTSH	X	X		X	X	
CHAP/RE	X	X	X	X	X	
M1	X	X	X			
PERSHING	X	X	X	X	X	
MACE		X	X			

LISTING 5

STATISTICS USED IN TEAS TO EVALUATE THE DIFFERENCE BETWEEN GROUPS

	PARAMETRIC TESTS					NONPARAMETRIC TESTS			
STUDY	Z TEST	STUDENT'S T-TEST	ANALYSIS OF VARIANCE	MULTIPLE COMPARISONS SCHEFFE	MULTIPLE COMPARISONS LSD	CHI-SQUARE	FISHER'S EXACT PROBABILITY	WILCOXON	MANN-WHITNEY U
BRM			X		X		X		
RE WSTEA		X	X		X				
M60			X		X				
MAGLAD/IRETS		X	X	X					
MLRS		X	X						X
PATRIOT		X	X				X	X	X
VULCAN		X	X						
CFV		X				X			
ATS	X					X			
PA:MOUT		X	X			X			
PA:5.56mm		X	X	X					
FIREFINDER		X							
ADA ACC		X	X	X		X			
CHAP/RE		X	X		X				
TAPIMA			X		X	X			
M1	X		X					X	
ADA UPDATE		X				X			
M1 UCOFT	X	X				X		X	X
MILES AGES/AD		X					X		
PERSHING	X	X	X	X		X			
UH60FS		X	X				X		
M1 DVR TNR	X	X				X			
FV UCOFT		X				X			
35H & 35B						X		X	
BTMS						X	X		
MACE			X						

LISTING 6
STATISTICS USED IN STUDIES TO
DETERMINE EXTENT TWO OR MORE VARIABLES ARE RELATED

STUDY	CORRELATIONS		REGRESSION
	PEARSON *PRODUCT MOMENT*	SPEARMAN *RHO*	
BRM	X		X
RE WSTEA	X		
M60	X		X
RE ARTS	X		
MAGLAD/IRETS		X	X
PATRIOT		X	X*
VULCAN	X		
CFV		X	
ATS			X*
ADA ACC			X*
NTSH		X	
CHAP/RE		X	
TAPIMA	X		
M1	X		X
PERSHING		X	X*
M1 UCOFT	X		
FV UCOFT	X		
35H & 35B			X*
ASVAB LR			X*

* This was discriminant analysis

END

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